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P. M. RAINEY

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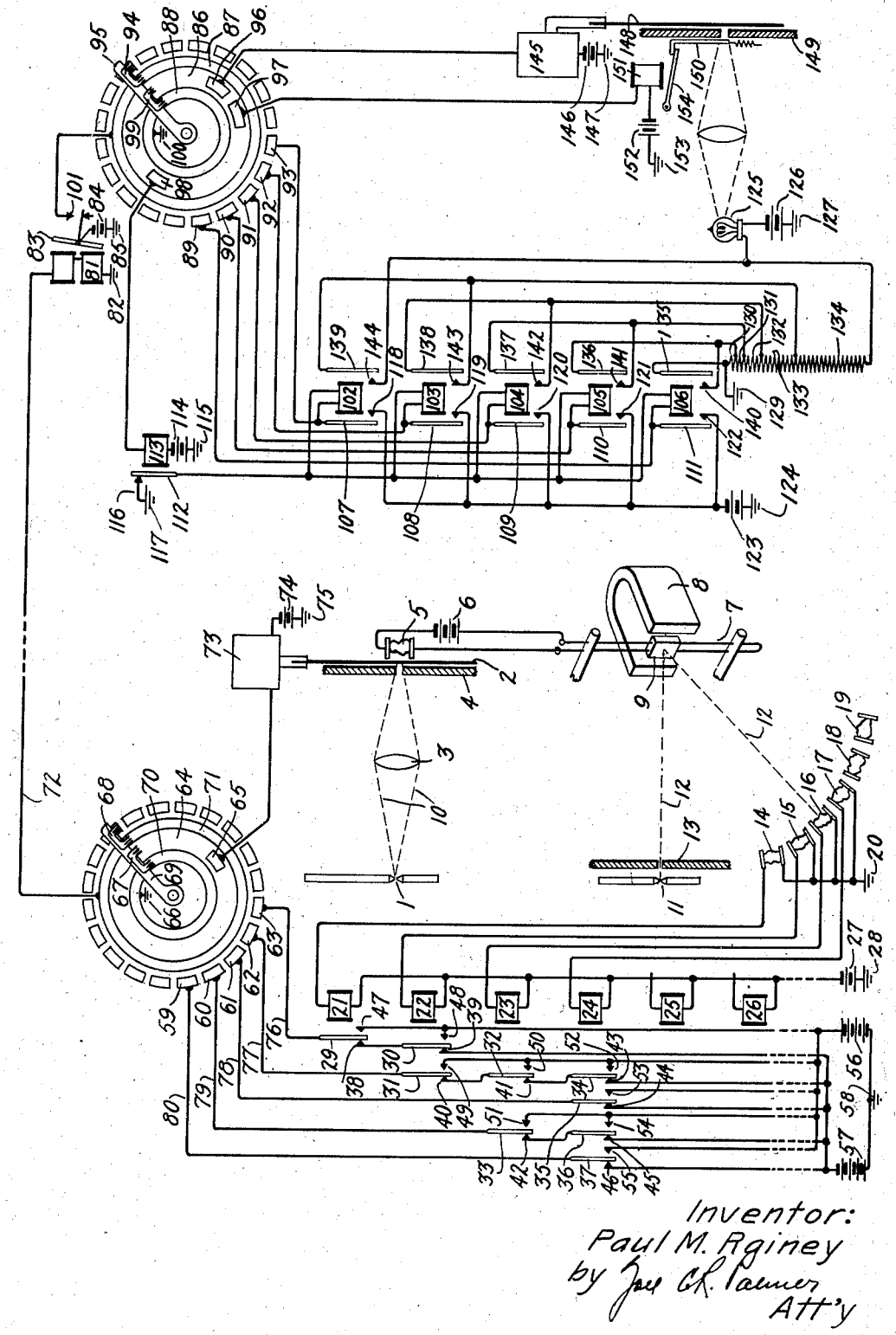

Inventor:
Paul M. Rainey
by Jas. Ch. Palmer
Att'y

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PAUL M. RAINEY, OF GLEN RIDGE, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

FACSIMILE TELEGRAPH SYSTEM.

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This invention relates to a system for transmitting facsimiles by means of electrical impulses.

An object of this invention is to provide means whereby facsimiles of pictures, drawings or the like may be transmitted by means of code combinations or permutations of electrical impulses.

Another object is to provide means whereby facsimiles of pictures and the like may be transmitted over systems which operate either intermittently or synchronously.

Another object is to provide a system which is efficient and reliable.

A system of this kind has the following advantages:

The facsimile apparatus may be connected to existing telegraph transmitting and receiving apparatus without materially altering the telegraph equipment.

The electrical impulses representing the facsimiles may be passed through a telegraph repeater, the same as regular telegraph signals, without necessitating any change or adjustment of the repeater.

One embodiment of the invention is illustrated in the accompanying drawing wherein the facsimile transmitting and receiving mechanism is associated with a multiplex synchronous telegraph system.

A source of light 1, is provided to illuminate a predetermined area of a negative or transparency 2 of the facsimile to be transmitted. A lens 3 which converges the diverging rays 10 emanating from the light 1 and a stop 4 which restricts the area of exposure of the transparency, are interposed between the source of light 1 and the transparency 2. A light sensitive cell 5 connected in series with a battery 6, and a galvanometer coil 7 is arranged to be acted upon by the rays of light passing through the transparency.

The light sensitive cell 5 may consist of a selenium cell which has the pecularities of being a very poor conductor of electricity in the dark and a good conductor of electricity in the light, although other means may be employed.

Mounted on the galvanometer coil 7, which is located between the poles of the magnet 8, is a reflector or mirror 9. The coil 7 is so mounted that it may be deflected when the current passing through the coil is varied.

A second source of light 11 is provided which projects a beam or ray of light 12 through a stop 13 to the reflector or mirror 9. This beam of light is reflected, and as the mirror is turned or rotated, the reflected ray of light will strike a predetermined one or number of a plurality of light sensitive cells 14, 15, 16, 17, etc., such as selenium cells. One terminal of each cell is grounded at 20, and the other terminals are connected to relays 21 to 26 respectively, the other terminals of the relays being connected to grounded battery 27. Cooperating with the relays 21 to 26 inclusive, are armatures 29 to 37 inclusive which are connected to segments 59 to 63 inclusive, of a distributor 64 through the circuits 76 to 80 inclusive. When the apparatus is at rest, the armatures 29 to 37 inclusive, engage contact points 38 to 46 inclusive, which are connected to the negative pole of battery 57 which is grounded at 58. Contact points 47 to 55 inclusive, connected to the positive pole of battery 56 which is also grounded at 58, are provided and these are so located that upon energization of a relay, the relay armature may be drawn into contact with the contact points with which it is associated.

Only six light sensitive cells 14 to 19 inclusive, and six relays 21 to 26 inclusive, with their cooperating armatures are shown. It will be understood that any number of cells and relays may be used depending upon the code employed. For example, in employing a five unit code as herein disclosed, a total of 32 cells and 32 relays may be used. The number of cells and relays employed would obviously depend upon the accuracy or gradations desired of the facsimile to be reproduced.

The distributor 64 consists of two rings 70 and 71, a plurality of segments 59, 60, 61, etc., and a rotating arm 69 on which are mounted two brushes 67 and 68. The ring 70 is grounded at 66 and ring 71 is connected to line 72. Brush 67 on the arm 69 makes contact between the segment 65 and ring 70 once during each revolution.

In the embodiment shown, the distributor arm 69 is rotated at a definite predetermined speed, and the distributor arm at the receiv-

ing station is maintained in synchronism with the sending distributor by any of the well known synchronizing means, such, for example, as disclosed in Rainey Patent No. 1,292,048 of January 21, 1919. However, the invention also contemplates the employment of start-stop distributing systems such as disclosed in Rainey-Dowd Patent No. 1,378,978, May 24, 1921.

Mechanism for advancing the transparency step-by-step is shown diagrammatically at 73. This mechanism may be similar to the character feed and line feed mechanism employed in a receiving printer, which is well known in the art. It is necessary that the mechanism 73 be arranged to advance the transparency a predetermined amount, for example, one step for the transmission of impulses representing each predetermined area of the transparency. The stepping mechanism may be actuated each time the brush 67 engages segment 65 of the distributor to complete a circuit from grounded battery 74 to the mechanism 73.

The distance the transparency 2 is moved each time may be varied, depending upon the desired shade or accuracy of the facsimile. Half-tone pictures are often taken through screens as coarse as 40 per inch. In such a case each step or movement of the transparency 2 would be one fortieth of an inch. Assuming this scheme working on one channel of a quadruple multiplex system which operates at fifty words per minute, it would require 5 and ⅓ minutes to reproduce a picture of one square inch.

Line conductor 72 is connected to a polarized relay 81 which is grounded at 82, and provided with an armature 83, which is connected through battery 84 to ground at 85. As armature 83 is operated by the relay 81, it serves to make and break contact between distributor 86 and battery 84. Distributor 86 consists of two rings 87 and 88, a number of segments such as 89 to 93 inclusive, located in the path of the brush 94 mounted on the rotating arm 95, and segments 96, 97 and 98 which are located in the path of the brush 99 also mounted on the rotating arm 95. The ring 88 is grounded at 100 and ring 87 is connected to contact point 101. The arm 95 is rotated in synchronism with arm 69 of distributor 64.

The segments 93 to 89 inclusive, are connected to the windings of relays 102 to 106 inclusive and corresponding armatures 107 to 111 inclusive. The other terminals of the relays 102 to 106 inclusive, are connected to the armature 112 of relay 113, which is connected in series with segment 98 of the distributor 86 and battery 114, which is grounded at 115. A back contact 116 of relay 113 is grounded at 117 and is normally closed. Cooperating with armatures 107 to 111 inclusive, are contacts 118 to 122 inclusive, which are connected to battery 123, which is grounded at 124. The armatures 107 to 111 inclusive, under normal conditions do not engage contact points 118 to 122 inclusive, but upon the energization of any one of the relays, the associated armatures are drawn into engagement with the associated contacts.

A lamp 125 is connected in series with a grounded battery 126 and a resistance consisting of five sections 130 to 134 inclusive, which is connected to ground at 129. The resistance sections 130 to 134 inclusive, may be used singly or may be connected in various combinations to control the amount of light emitted by the lamp 125 and consequently the amount transmitted to the sensitized plate 148.

Armatures 135 to 139 inclusive, and corresponding contacts 140 to 144 inclusive, are normally disengaged, but upon energization of the respective relays 102 to 106, the armatures and cooperating contacts are connected in circuit with the different resistance sections 130 to 134.

Segment 96 of distributor 86 is connected to a feeding mechanism 145 which is similar to and is operated in unison with the corresponding mechanism 73 at the transmitting station, that is, the mechanism 145 serves to advance the sensitized plate 148 in unison with the transparency 2. A stop 149 is arranged in front of the plate 148 and a shutter 150 controlled by the armature 154 of a magnet 151 is provided to control an aperture in the stop 149 through which rays of light pass to the sensitized plate 148. The magnet 151 is connected in series with grounded battery 152 and local segment 97 of the receiving distributor.

The operation of the system is as follows: Rays of light from the source of light 1 illuminate a predetermined area of the transparency 2 and a certain amount of the light passes through the transparency to the light sensitive cell 5. This changes the resistance of the cell 5 which causes the current to change to a certain value, depending upon the amount of light passing through the transparency 2. The change of current causes the galvanometer coil to deflect to a certain definite position. A pencil of light projected upon the mirror 9 from the source of light 11 is reflected and falls upon one or more of the light sensitive cells 14 to 19 inclusive. Suppose the light to fall upon cell 16 as shown in the diagram, then the resistance of cell 16 is decreased, and sufficient current flows from battery 27 through relay 23, cell 16 and to ground at 20 to cause relay 23 to operate armatures 32 and 33 to engage contact points 50 and 51 respectively. After this operation segments 59, 61 and 63 are connected to the negative pole of battery 57 and segments 60 and 62 are connected to

the positive pole of battery 56. This sets up a certain combination of circuits in conjunction with the transmitting apparatus and as arm 69 rotates, it connects the segments in turn to the ring 71 which is connected to line 72. Thus certain impulses are sent over the line. After the rotating arm 69 has passed over segment 63 it brings brush 67 into contact with segment 65 and completes a circuit from battery 74, through the transparency feeding device 73. This moves the transparency one step which may alter the amount of light passing through the transparency 2. If the amount of light passing through the transparency is changed, the current in the galvanometer coil is also changed and the mirror takes up a new position which controls the setting up of a new combination of circuits in conjunction with the distributor.

The impulses sent over line 72 energize the relay 81 which operates armature 83 to control the energizing circuits of relays 102 to 106 inclusive. Take for example, the combination set up when the light sensitive cell 16 is illuminated so as to operate relay 23, then segments 59, 61 and 63 are connected to the negative terminal of the battery 57 and segments 60 and 62 are connected to the positive terminal of battery 56. Therefore as arm 69 rotates and brush 68 comes in contact with segment 59, a negative impulse, which operates relay 81 to break the circuit through distributor 86, is sent over the line. When the brush 68 contacts with segment 60 a positive impulse is sent over the line and it operates relay 81 which completes the circuit of the distributor 86 and as arm 95 rotates in synchronism with arm 69 of the distributor 64, brush 94 connects segment 90 to ring 87 and thus relay 105 is operated. For the particular combination of circuits set up in conjunction with distributor 64, one other positive impulse is sent over the line and operates relay 103. The operation of relays 105 and 103 makes contact between armature 136 and contact 141 and armature 138 and contact 143. This shunts the resistance sections 131 and 133 and reduces the resistance of the lamp circuit and consequently increases the intensity of the light. The relays 105 and 103 also make contact between armature 110 and contact 121 and armature 108 and contact 119 which completes a circuit from battery 123 through relays 105 and 103 in parallel and armature 112 to ground at 117. This retains armatures 136, 138, 110 and 108 in engagement with contact points 141, 143, 121 and 119 respectively, until the relay circuit including battery 123 is broken by the operation of relay 113. The relays 102 to 106 and the resistance sections 130 to 134 make it possible to obtain thirty-two different degrees of light.

After the arm 95 has passed over the segments 89 to 93 inclusive, it carries brush 99 into contact with segment 97 and completes the circuit of magnet 151, which attracts the armature 154 and opens shutter 150 for an instant, exposing the sensitive plate 148 to the rays of light from lamp 125. Then brush 99 comes in contact with segment 96 and completes the circuit of the receiving plate moving apparatus 145 which moves the sensitized plate 148 one step. The next circuit established is when brush 99 comes in contact with segment 98 when the circuit of relay 113 is completed and armature 112 is operated to break the relay circuit which includes battery 123, relays 105 and 103 in parallel, armature 112 and ground connection 117. This releases armatures 136, 138, 110 and 108 which return to normal and the lamp circuit 125 with all the resistance sections 130 to 134 inclusive, in series is re-established.

The transparency 2 has been moved one step and if the density of the second area illuminated is different from the density of the first area the amount of light falling upon cell 5 is changed. This changes the current flowing through the galvanometer coil and the mirror is rotated to a new position where it illuminates one or more of the other sensitive cells and sets up a new combination of circuits in conjunction with distributor 64 and a new combination of impulses is sent over line 72.

What is claimed is:

1. The method of transmitting pictures by electricity which comprises transmitting a code combination of electrical impulses for each elemental area of the picture, utilizing said combinations to correspondingly vary the intensity of a light beam, and causing said beam to reproduce the picture on a sensitized form at a distant station.

2. The method of transmitting pictures by electricity which comprises transmitting a predetermined code combination of electrical impulses for each elemental area of the picture, and translating said impulses into variations of a beam of light to reproduce the picture transmitted.

3. A system for transmitting facsimiles, an image of the facsimile to be transmitted, means controlled by said image to transmit code combinations of electrical impulses representing each elemental tone value of the picture, a light beam, and receiving means responsive to said code combinations to vary the intensity of said beam for reproducing a likeness of said image.

4. A system for transmitting facsimiles of pictures by combinations of electrical impulses representing each elemental tone value of the picture comprising transmitting and distributing apparatus, a transparency of the image to be transmitted, means re-

sponsive to light rays emitted through said transparency, means responsive to said last mentioned means whereby predetermined combinations of impulses are transmitted according to the density of each elemental area of the transparency, and means for translating said impulses into variations of intensity of a beam of light.

5. A system for transmitting and reproducing facsimiles by combinations of electrical impulses comprising transmitting and distributing apparatus, a transparency of the image to be transmitted, light sensitive means responsive to light rays emitted through said transparency, means responsive to said last mentioned means whereby predetermined combinations of impulses of uniform length are transmitted according to the density of the transparency, a source of light, and means responsive to said combinations of impulses for varying the intensity of the light from said source.

6. A system for transmitting facsimiles comprising a telegraph system including transmitting and receiving apparatus, a transparency of the image to be transmitted, means controlled by said transparency to operate the transmitting apparatus to send combinations of impulses as determined by the density of each elemental area of the transparency, an element with a photosensitive surface, and means operated by said receiving apparatus to produce a single exposure of said surface for each combination of impulses transmitted.

7. A system for transmitting pictures comprising a multiplex telegraph system including distributors, transmitting and receiving apparatus, a line circuit, a light for illuminating successive areas of the picture being transmitted, means for operating said transmitting apparatus to set up predetermined combinations of electric circuits to send combinations of impulses over said line for each elemental area of the transparency, said means being controlled by the intensity of the light from the picture, means for receiving said impulses, means for using said impulses to vary the intensity of a beam of light, and a sensitive plate upon successive areas of which said varying light is projected.

8. In combination with transmitting and receiving apparatus, a line circuit, means for transmitting pictures comprising a transparency of the picture to be transmitted, means for illuminating successive areas of said transparency, means depending upon the intensity of the light passing through the successive areas of said transparency to operate the transmitting apparatus to send combinations of impulses over said line for each elemental area of the transparency, means for receiving said impulses, a source of light and means depending upon said impulses for varying the intensity of the light from said source, a sensitive plate and means for concentrating the rays from said light of varying intensity upon successive areas of said sensitive plate to reproduce a picture on said transparency.

9. A system for transmitting pictures, including transmitting and receiving apparatus, a transparency of the picture to be transmitted, means for moving said transparency over a predetermined path, a source of light for illuminating successive sections of said transparency, a circuit including a light sensitive cell, a battery and a galvanometer coil on which is mounted a mirror, said cell being so located that the rays of light passing through said transparency fall upon it to vary the current in the circuit as the intensity of the light falling upon the cell varies, said mirror being deflected as the current varies, a source of light to illuminate said mirror, a plurality of light sensitive cells located in the path of the rays reflected from said mirror, transmitting apparatus operated by the increase in current due to the illumination of one of said plurality of light sensitive cells to send impulses over said line, receiving apparatus to receive said impulses, a source of light, the intensity of which is varied through said receiving apparatus by said impulses, and a light sensitive surface illuminated by said light to record the effect of said impulses.

10. A system for transmitting and reproducing facsimiles comprising transmitting and receiving distributing apparatus, a line circuit connecting said apparatus, a transparency of the image to be transmitted, means for moving said transparency at regular predetermined intervals, a source of light for illuminating successive sections of said transparency, a light sensitive cell responsive to light emitted through said transparency, a circuit for said cell, means included in said circuit and responsive to variations of current therein for determining the combinations of impulses to be transmitted for each elemental area, a receiving apparatus to receive said impulses, a source of light associated with said receiving apparatus the intensity of which is controlled by said impulses, and a sensitized plate illuminated by said light to record the effects of said impulses.

11. In a system for transmitting pictures, a line, transmitting apparatus at one end of the line for transmitting code combinations of impulses in accordance with different densities of the transparency of a picture to be transmitted, receiving means at the other end of said line comprising a sensitive plate, a source of light, a plurality of relays controlling the intensity of said light, and a distributor for distributing to said relays code combinations of impulses transmitted to

reproduce the picture on said sensitive plate.

12. In a system for transmitting pictures, a line, a transmitting apparatus connected at one end of said line comprising a plurality of light sensitive devices controlled by light rays passing through the transparency of a picture to be transmitted, a plurality of relays operated in accordance with the operation of the associated light sensitive devices, a distributor for transmitting over said line impulses in accordance with the operation of said relay, and recording means at the opposite end of said line for reproducing the image thus transmitted.

13. In a system for transmitting pictures a line, transmitting apparatus at one end of said line comprising a plurality of light sensitive devices, a source of light, an electro-responsive device deflected in accordance with the intensity of a light source passing through the transparency of the picture for controlling the application of said source of light to the light sensitive devices, a plurality of relays controlled by the light sensitive devices, and a distributor for transmitting over said line code combinations of impulses as determined by the operation of said relays, and recording means at the opposite end of said line for reproducing the image thus transmitted.

14. The method of transmitting a picture by electricity which comprises automatically transmitting a code combination of electrical impulses for each elemental area of the picture, the impulses in each combination being equal in number and automatically permuted to indicate the tone value of the corresponding elemental area of the picture recording said permuted combination, and varying the degree of exposure of a photosensitive surface in accordance with said recorded combinations.

15. In a system of telephotography, means for making tests of successive elemental areas of a picture, light sensitive means responsive to said tests, means for producing combinations of impulses, each combination consisting of an equal number of elements of equal duration, means controlled by said light responsive means to permute the elements in each combination in accordance with the degree of tone value of elemental areas tested, means for recording said permuted combinations, an element with a photosensitive surface, means for exposing said surface in successive areas, the degree of exposure of each area being determined by the corresponding record on said recording means.

16. In a system of telephotography, an image of the picture to be transmitted, means controlled by said image for transmitting a combination of current elements for each elemental area of said image, each combination comprising an equal number of elements permuted in accordance with the tone value of the corresponding elemental area, means for recording said permuted combinations, an element with a photosensitive surface, means controlled by said recording means for exposing said surface to light varying in intensity in accordance with successive combinations recorded on said recording means.

In witness whereof, I hereunto subscribe my name this thirteenth day of July A. D., 1921.

PAUL M. RAINEY.